

Health-Care Networks and the Impact of Maternal Health Care Projects – the Cases of Peru and Bolivia

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This paper shows that the evaluation of health projects can be inaccurate when it only considers the direct health-care services provided by health facilities, and that the effects on the entire health-care network must be considered. In Peru's case, we found that an important effect of a new health facility is the improved service quality in the neighbouring facilities. In Bolivia's case, we found that an improvement of maternal health care service in one hospital may just reduce the demand for medical services in other primary health facilities without significantly affecting the overall performance of the health-care network.

Keywords: *Health-care network, Facility-based deliveries, Maternal and child health care, maternal mortality rate, infant mortality rate*

I. INTRODUCTION

When evaluating projects of international cooperation in developing countries such as those involving improvements to medical facilities or empowerments of the medical labour force, it is common to evaluate the effectiveness of the project by quantitatively and qualitatively measuring the improvements in services at the hospital where the intervention was carried out (KOICA 2014a). For example, the construction or extension of a hospital or a health care centre may result in increased numbers of patients and surgical procedures, new medical treatments, improvements of medical treatment conditions at that facility, and these were considered to be the final or most important outcomes of the project (KOICA 2012). However, due to the nature of medical services, judging the effects of a new medical facility only by observing direct changes at that facility is inaccurate or even misleading. This is because medical services provided within a medical catchment area are not provided by a single hospital but via the health-care network as a whole (Koblinsky 2003). This means that any intervention or improvement of medical facilities and empowerment of the medical labour force, will not only change the quality, the supply and the demand of the health-care service at the particular facility, but also the entire health-care network that the facility forms part of. Therefore, any analysis of the effectiveness of a project should comprehensively consider the health-care network as a whole.

This paper demonstrates that an evaluation of the Korea International Cooperation Agency (KOICA) Maternal and Child Health Care Project in Peru and Bolivia can be inaccurate when it only considers the provision of direct health-care services, and that a thorough analysis needs to consider the entire network including the hospitals that are directly involved (KOICA 2014b).¹ In the first part of the paper we introduce the concept of health care network, and analyse the welfare effects of an establishment of a new hospital in

¹ Korea International Cooperation Agency(KOICA) is a Korean governmental agency dedicated to providing grant aid programs of the Korean government.

a health-care network. In the second part, we evaluate the economic effects of the KOICA projects in Peru and Bolivia based on the framework suggested in the first part.

2. ANALYSIS FRAMEWORK OF HEALTH-CARE NETWORK

A health-care network generally refers to several interconnected health-care agents that act together to provide the medical services used by a certain population (Vázquez et al 2009; PAHO 2012). At the national level, a health-care network includes all the services that people obtain from public or private health-care providers, who can be divided into primary, secondary and tertiary providers (Koblinsky 2003). A health-care network involves a health-care delivery system whereby any patients requiring treatments that are not available in primary health-care are transferred to secondary health-care via a requesting system, and then to a tertiary hospital if necessary (Bossert et al. 2014). Also, if any particular hospital is not open for some reason, such as maintenance work, patients can visit any other, which means that all of the health-care providers work together as a single network (Ocampo-Rodríguez et al. 2013).

Figure 1 shows a representation of a nationwide network, in which the blue circles show the local networks. Each local network consists of primary and secondary hospitals (PAHO 2011; PAHO 2014). People in the local network generally visit the primary hospital that is located closest to their residence, but they can also visit any other primary hospitals within their local network (Montenegro et al. 2013). They can also go to other local networks to receive services, but this is very rare because of the distance (Montenegro et al. 2011).

Our main argument is that an evaluation of a medical or health-care project at a particular hospital should include the possible effects on the entire health-care network, although these will probably be limited to within the relevant local network. For example, an evaluation of the effects of a new hospital building project should focus on how the number of patients or treatments within the network will increase. The evaluation should not be based solely on the statistics of the newly built hospital.

Figure 1. A health-care network

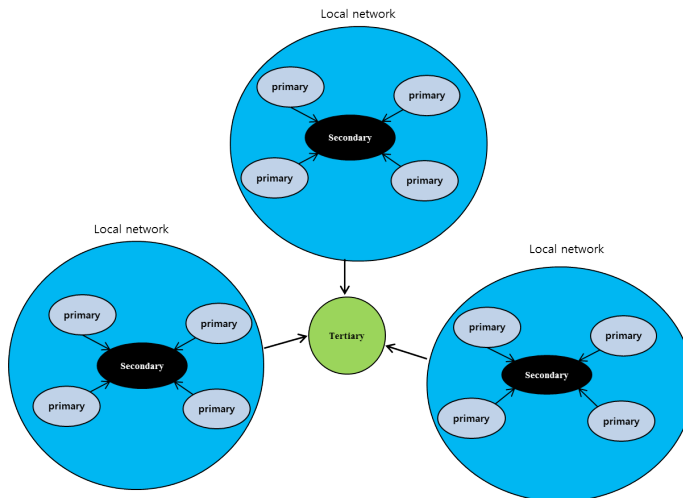
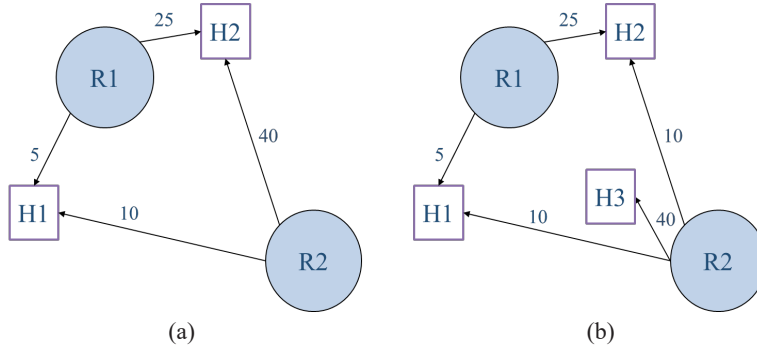


Figure 2. Local health care network and establishment of a new hospital

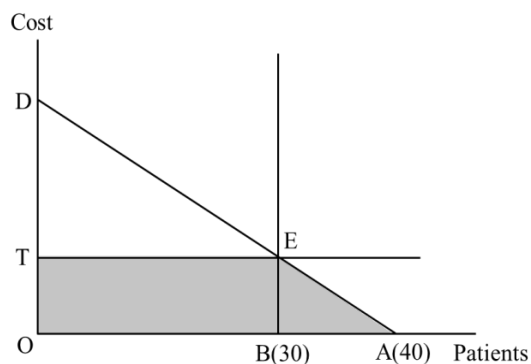
The reason for this is that the patients that are treated at the new hospital do not constitute new patients, since this will include people who used to go to other hospitals before the construction of the new one. This movement of patients is due to the government providing health-care services through the entire health-care network, rather than via a single health-care facility. For example, suppose that before a new hospital was built, the situation of a local health network was as in the Figure 2(a). The residents of the region R1 and R2 are using hospitals H1 and H2. From the region R2, 10 patients are using H1, and 40 patients H2. The hospital H2 is highly congested, so the waiting time was long and the service quality low. Besides, the residents at R2 had to make a long trip to go to the distant hospital H2. So to improve this situation, a new hospital (H3) was built close to R2, as shown in Figure 2(b). The number of patients visiting the new hospital H3 is 40, but not all of them are new patients. 30 patients changed hospital from H2 to H3. 10 patients, who did not receive medical service in the past because of the long distance to both H1 and H2, would visit the newly built hospital H3 thanks to the proximity.

The welfare effect of the patients visiting H3 is shown in Figure 3. DA, which is the demand curve for medical service, reflects the benefits of visiting the hospital.¹ OB(30 patients) used to visit the hospital H2 as the benefit is larger than the transportation cost T. After the new hospital H3 was built, they changed to H3 as they do not have to pay the transportation cost. The increase in their welfare is $\square OTEB$. BA(10 patients) did not go to any hospital as the benefit was smaller than the transportation cost T. Now with a new hospital close by they will visit H3. The increase of their welfare is $\triangle BEA$.

If there was no congestion cost in the hospital H2, the above mentioned welfare increase is the total welfare gain from the establishment of the new hospital, which is probably very small. However, if there was congestion and a consequent low quality service in H2, there will be a large welfare gain among the patients who used to visit H2, as the congestion will become much smaller or will disappear with the establishment of the new hospital H3. The presence of congestion is one of the important differences between the cases of Peru and Bolivia, which will be analysed in the next section.

If the hospital H3 is considered as an isolated hospital all the 40 patients would be treated as new patients, and the benefits of building a new hospital would be overestimated. Therefore, to estimate the right impact of a hospital building project, it must be evaluated within the context of local network. The analysis does not have to be at the national level,

¹ For simplicity, it is assumed that the cost to the patients is zero.

Figure 3. Welfare effects at the new hospital H3

since the local network is defined in such a way that the number of people coming in from outside the local network and going out to other networks is negligible. The methodology to prove this argument is the statistical analysis of the change in the number of treatments at the intervened facility as well as other neighbouring ones within the local health-care network. To do this, we first define the local health-care network and identify the health facilities within this network. Then, we collect the information on the number of treatments for the intervened and non-intervened facilities before and after the intervention. Finally, we analyse the information to show whether our argument is true or not. The variables we used are mostly those related to all deliveries, normal deliveries, complicated deliveries, still birth, infant mortality rate, maternal mortality rate. The sources of data were DIRESA (Direccion Regional de Salud del Callao), SEDES (Servicio Departamental De Salud La Paz), and the information provided by each facility.

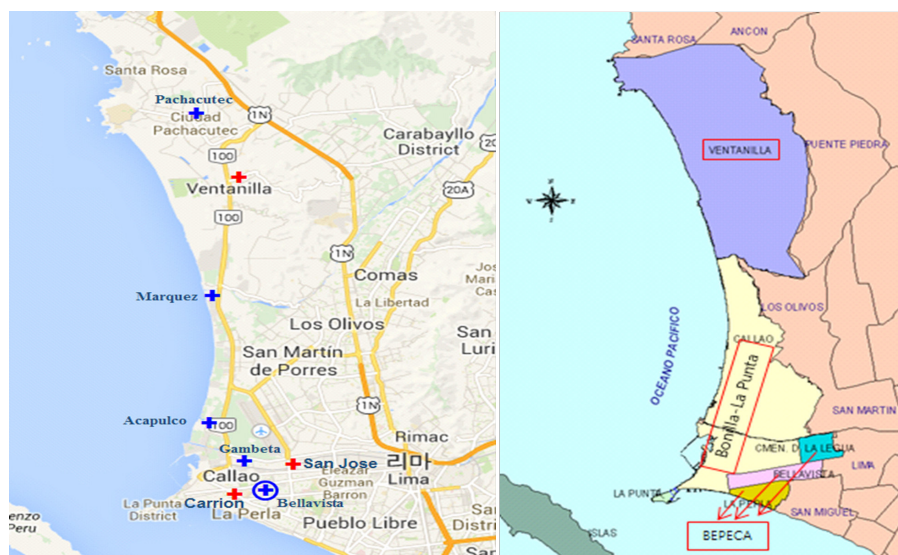
3. HEALTH-CARE NETWORK AND EVALUATION OF THE IMPACTS

3.1. Peru

1) Health Centre Project at Callao's Regional health-care network

The health-care delivery system in Peru consists of hospitals of levels I, II and III, and with a referral from a doctor it is possible for the patients to get a higher level of hospital care. However, patients are free to go to any hospital they want since the health-care delivery system operating via doctor referrals is not well established (PAHO 2011). The object of evaluation is Bellavista Health Centre in Callao Province, which was established at level I-4 (where child delivery is possible) with support from the KOICA. The purpose of the project was to increase the deliveries at facilities and reduce maternal and infant mortality rates.

Callao Province, which is located to the west of Lima, is made up of three health-care service networks: Red Bepeca, Red Ventanilla and Red Bonilla-La Punta (Bonilla) (Figure 4). Bellavista Health Centre, which has been supported by the KOICA, and San Jose Hospital (a secondary hospital) are part of the Bepeca network in the south. Ventanilla Hospital (another secondary hospital) is part of the Ventanilla network in the north. There is only one tertiary hospital, named Carrion, in the Bonilla network in the middle of Callao Province. Ideally residents go to their allocated health facilities, but some patients may go to

Figure 4. Map of the three health-care networks in the Callao Province

+: Facility where child delivery available (blue: level I health centre, red: secondary and/or tertiary hospital)

any health facilities of their choice. Callao Province can be considered to be a single health-care network since patients actively move within Callao Province but not very much out of it. In other words, the Callao network is made up of 40 health centres where delivery is not possible, 5 health centres (Marquez, Pachacutec, Gambeta, Acapulco and Bellavista) where delivery is possible, two secondary hospitals, and one tertiary hospital.

In Callao Province, there are five health centres at level I-4, one of which is Bellavista; they are primarily responsible for maternal and child health. The secondary hospitals are San Jose and Ventanilla, where caesarean sections and normal deliveries are possible. Both hospitals lack the facilities to treat infants with severe neonatal problems and complicated delivery cases, which are expected to be moved to a tertiary institution such as Carrion Hospital.

Bellavista Health Centre is part of the Bepeca network in Callao Province when classified as a medical administrative division. In the Bepeca network, San Jose Hospital is a secondary hospital that operates as a central hospital, but since the Bonilla network is adjacent to Bepeca, these two networks may appear to operate as a single network rather than separately. Carrion Hospital is in the Bonilla network and operates as a tertiary hospital both in Bonilla and Bepeca. Bellavista Health Centre is closer to Carrion Hospital than San Jose Hospital, which is in the same network as Bellavista. Patients prefer Carrion to San Jose as it is of a higher level.

2) Evaluation of the effects of constructing a health centre in a health-care network

Since most of the pregnant women in Callao Province prefer to go to Carrion Hospital, this tertiary hospital is overcrowded.² The local Callao government had established Bellavista

² This is based on interviews with local residents and medical personnel.

Table 1. Cases of deliveries and stillbirths at facilities in Callao Province

	Hospital				Health Centre				Total
	Carrion ^{a)}	San Jose ^{b)}	Ventanilla ^{c)}	Marquez	Pachacutec	Gambeta ^{d)}	Acapulco	Bellavista ^{e)}	
2006									
All deliveries	6,835	3,038	567	613	0	330	250	0	11,633
Normal deliveries	4,662	2,287	566	613	0	330	250	0	8,708
Caesarean	2,141	689	0	0	0	0	0	0	2,830
Complicated deliveries	32	62	1	0	0	0	0	0	95
2007									
All deliveries	5,565	2,680	2,071	213	0	299	141	0	10,969
Normal deliveries	3,711	1,944	1,961	213	0	299	141	0	8,269
Caesarean	1,819	683	105	0	0	0	0	0	2,607
Complicated	35	53	0	0	0	0	0	0	88
2008									
All deliveries	6,238	228	3,268	161	239	338	140	0	10,612
Normal deliveries	4,322	215	2,722	161	239	338	140	0	8,137
Caesarean	1,893	0	546	0	0	0	0	0	2,439
Complicated	23	13	0	0	0	0	0	0	36
2009									
All deliveries	6,480	322	3,164	215	423	244	135	0	10,983
Normal deliveries	4,608	278	2,655	215	423	244	135	0	8,558
Caesarean	1,840	38	509	0	0	0	0	0	2,387
Complicated	32	6	0	0	0	0	0	0	38
2010									
All deliveries	4,574	2,294	3,373	118	323	197	89	0	10,968
Normal deliveries	3,080	1,628	2,803	118	323	197	89	0	8,238
Caesarean	1,472	666	570	0	0	0	0	0	2,708
Complicated	22	0	0	0	0	0	0	0	22
2011									
All deliveries	3,094	3,235	3,523	114	308	229	156	101	10,760
Normal deliveries	1,894	2,093	2,774	114	308	229	156	101	7,669
Caesarean	1,188	1,139	749	0	0	0	0	0	3,076
Complicated	12	3	0	0	0	0	0	0	15
2012									
All deliveries	3,493	3,050	3,838	88	318	1	210	226	11,224
Normal deliveries	2,124	1,992	3,102	88	318	1	210	226	8,061
Caesarean	1,319	1,058	736	0	0	0	0	0	3,113
Complicated	50	0	0	0	0	0	0	0	50

	Hospital			Health Centre					Total
	Carrion ^{a)}	San Jose ^{b)}	Ventanilla ^{c)}	Marquez	Pachacutec	Gambeta ^{d)}	Acapulco	Bellavista ^{e)}	
2013									
All deliveries	3,523	2,671	3,990	105	387	134	168	190	11,168
Normal deliveries	2,246	1,619	2,873	105	387	134	168	190	7,722
Caesarean	1,218	1,052	1,117	0	0	0	0	0	3,387
Complicated	59	0	0	0	0	0	0	0	59

Source: DIRESA Callao(<http://www.diresacallao.gob.pe/wdiresa/estadistica.php>)

^{a)} Carrion Hospital is a tertiary hospital, whereas San Jose and Ventanilla are secondary hospitals.

^{b)} San Jose Hospital during 2008 and 2009

^{c)} Ventanilla Hospital was upgraded to a secondary hospital in 2007

^{d)} Gambeta Health Centre was under renovation in 2011.

^{e)} Bellavista Health Centre was renovated in 2010.

Health Centre, a level I-4 health centre, in order to distribute an acceptable workload to each hospital. For primary, secondary and tertiary hospitals to run according to their intended purpose, a level I-4 health centre should take charge of a good portion of normal deliveries, level II hospitals (secondary) should be responsible for normal deliveries and caesarean sections, and level III hospitals (tertiary) should only take complicated deliveries.

The delivery cases at Bellavista Health Centre from 2006 to 2013 are presented in Table 1. There were 101, 226 and 190 delivery cases in 2011, 2012 and 2013, respectively. The Callao government considers that this facility could perform up to 1000 cases annually. Therefore, at the present Bellavista Health Centre is considered to be highly underutilized.

Nevertheless, if Bellavista Health Centre is considered as an isolated health care centre, the deliveries in this centre could be taken as a net increase in deliveries at facilities. However, the total number of facility-based deliveries in the Callao Province was 11,633 in 2006 and 11,168 in 2013; that is, showing no marked change (Table 1). This stable number of facility-based deliveries was maintained in spite of significant fluctuations in the number of deliveries at each health facility. In terms of hospitals, since Ventanilla Hospital was upgraded to a secondary hospital in 2007, it can be inferred that patients moved from San Jose and Carrion to Ventanilla Hospital (Table 1). Renovations at San Jose Hospital caused the delivery cases at Carrion Hospital and Ventanilla Hospital to increase dramatically during 2008 and 2009 compared to 2007. San Jose Hospital reopened in 2010, which reduced the number of deliveries at Carrion Hospital by up to 2,000. These fluctuations in the number of deliveries suggest that patients of San Jose Hospital moved to Carrion Hospital during the renovation and then came back from the middle of 2010. In 2008, the burden of Ventanilla Hospital was reduced due to a delivery service introduced at Pachacutec Health Centre in the same network. In 2011, Gambeta Health Centre was under renovation, and during this period it can be presumed that pregnant patients moved to Carrion Hospital.

The deliveries at Bellavista Health Centre may be seen as just a movement of pregnant women from Carrion Hospital to Bellavista Health Centre, without significant social benefits. However, the opening of Bellavista Health Centre in 2011 reduced the burden at Carrion Hospital, which was overcrowded and consequently experienced degradation in the service quality. Some pregnant women at San Jose Hospital may also have changed to Bellavista Health Centre. This was consistent with the aim of the Peruvian government to prevent overcrowding of tertiary hospital by funding Bellavista Health Centre, which is a primary

Table 2. Maternal and infant mortality rates in Callao Province and the Bellavista region

	Infant mortality rate (per 1,000 live births)		Maternal mortality rate (per 1,000 live births)	
	Callao Province	Bellavista region	Callao Province	Bellavista region
2008	7.44	23.12	0.04	0.44
2009	9.16	17.81	0.04	0.44
2010	6.87	27.5	0.04	0.4
2011	5.95	16.04	0.06	0.59
2012	7.46	31.7	0.04	0.45
2013	10.55	23.35	0.05	0.56

Source: DIRESA Callao(<http://www.diresacallao.gob.pe/wdiresa/estadistica.php>)

hospital.

The Peruvian Ministry of Health implemented the policy to lead normal deliveries to primary health care centres, and to reduce the workload for normal deliveries at secondary and tertiary hospitals. Even if Carrion Hospital is a tertiary hospital, which has to deal with severe and complicated medical cases, it did not have the capacity to cope with severe cases because of the overload coming from a large number of normal deliveries. Pregnant woman also suffered from the inconvenience of having to wait for weeks before being consulted, waiting for hours on the day of a consultation, and having very short consultation time.³

Despite a government policy for normal deliveries to be performed at health centres, many people seem to prefer going to secondary and tertiary hospitals. There are 5 health centres where delivery is possible and 1,000 cases annually, which is only 10% of the total number of childbirths (about 11,000 cases) at public health centres (Table 1).

The maternal mortality rates in Callao Province and the Bellavista region do not seem to have been affected by the delivery service in Bellavista Health Centre, since they did not differ, or even increased slightly, between before and after the construction project (Table 2). However, the number of deliveries at Bellavista Health Centre is about 200 per year, and since this is less than 2% of the entire Callao Province, it is unlikely to significantly affect any health index.

The maternal and infant mortality rates seemed to be much higher in the Bellavista region than the average across the entire Callao Province. This is because Carrion Hospital (which is a tertiary hospital) belongs to the Bellavista region according to administrative districts, and most stillbirths occur in tertiary hospitals, with the remainder occurring in secondary hospitals (Table 1). Bellavista Health Centre had no complicated deliveries or cases of stillbirth since it is a public health centre that only deals with normal deliveries, and if even a slight problem is encountered, the mother is referred to a secondary or tertiary hospital.

3) Impact

The Peruvian government has a policy of letting public health centres to share some burden normal deliveries, so that tertiary hospitals can concentrate on complicated delivery

³ This is based on interviews with local residents and medical personnel.

cases. Bellavista Health Centre was established for this purpose, to deal with normal delivery cases and to help Carrion Hospital in handling complicated cases. Therefore, it would be incorrect to evaluate the project according to the number of deliveries or the service quality at Bellavista. The data from Callao Province indicate that the construction of Bellavista Health Centre resulted in 200 normal deliveries annually, but this is not a net increase since it is the result of movements of patients from one hospital to another.

The effects of the Bellavista Health Centre project should therefore be evaluated in terms of the increase in the quality and convenience of the services in the neighbouring facilities rather than the increase in the number of services. If eventually 500 out of 4,000 women who would give birth at Carrion Hospital move to Bellavista Health Centre, the economic welfare effects can be calculated as follows: First, there will be an improved service quality at Carrion Hospital since (i) the 4,000 pregnant women still visiting Carrion Hospital do not have to wait so many weeks for a consultation, and to wait so many hours in the day of consultation, (ii) the doctor can spend more time with each patient, improving the service quality, and (iii) the number of medical error may be reduced. Second, there will be benefits at Bellavista Health Centre since (i) those patients residing close to Bellavista Health Centre will visit it more frequently than when they have to go to other hospitals, and (ii) they can receive better service because there is no congestion or overwork of the doctors.

The delivery rate at Bellavista Health Centre, 200 cases annually, does not currently meet its goal of 1,000 cases, and so the positive effects will increase as more patients move from Carrion Hospital to Bellavista Health Centre. Bellavista Health Centre acts as a primary health facility, but the number of deliveries is relatively small. It will be necessary to increase deliveries so as to further reduce overcrowding at Carrion Hospital, and to maximize the positive effects on the Peruvian health-care system. Many people are unwilling to have their baby delivered at a health centre even when the actual statistics demonstrate that there is no difference in the rate of accidents or problems.⁴ For Bellavista Health Centre and Carrion Hospital to fulfil their intended purposes and to contribute to improving the welfare of the country, improvements to the understanding of their roles and a change of people's perception seem to be important.

3.2. Bolivia

1) Health Centre Project at El Alto city health-care network

Bolivia's health-care system is one of the most fragmented amongst Latin American countries (Rivera et al. 2006; Ledo and Soria 2011), and one of its key traits is wide categories of overlooked areas. There are many health sectors including public and private ones, public sector serving the largest number of people. Although patients can move freely between public and private sectors, the number of local residents using for-profit privately run hospitals remains small due to their high costs relative to the public services. The employment based health insurance remain limited to selected individuals, amounting to around 23% of the entire population (Rivera et al. 2006). While health-care services of the public sector are open to all individuals, it is only free with insurance; without insurance, costs must be fully paid by patients themselves since no subsidies are provided by the government.

The KOICA project targets El Alto city, which is next to La Paz (the capital of Bolivia)

⁴ This is based on interviews with local residents and medical personnel.

Table 3. Number of medical facilities in El Alto city

Type of sector	Public	Employment insurance	Private (for profit)	Private (church)	Support	Total
Number of facilities	53	6	6	9	19	93

Source: Source: SERES. (<http://www.sedeslapaz.gob.bo/>)

Note: Since traditional medical services rarely have full facilities and infrastructure, and it is difficult to find data for analysis, they have been excluded from these statistics

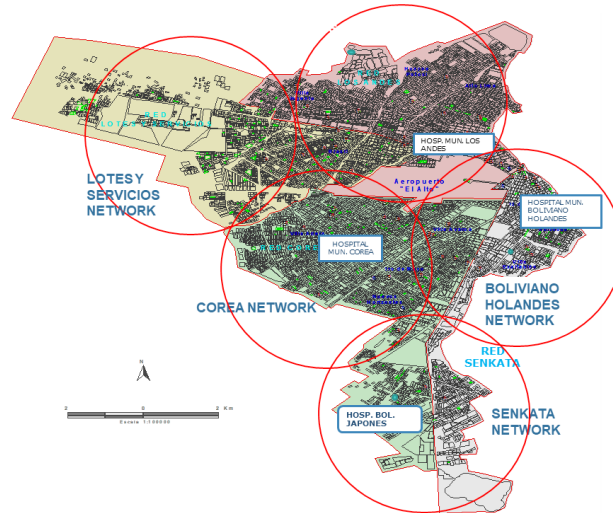
and is located at an altitude of 4,000 meters. The population is increasing dramatically, reaching 990,000 in 2013, and the city has a large proportion of low-income people.

The health-care system within El Alto city is identical to the health-care system of Bolivia (Koblinsky 2003). Among the many health sectors, the public sector is the most important to health-care service provision (Table 3). The public sector is divided into regional units of primary, secondary and tertiary hospitals that compose health-care service networks through which services are provided. The primary medical facility is the health centre (Centro de Salud) composed of a small number of doctors, nurses and basic medical equipment. El Alto city has 49 health centres. Secondary medical facilities are equipped with the capacity to treat patients in more than five areas of medical treatment, and Corea Hospital, which is the object of evaluation in this study, is also a secondary medical facility. There are four secondary hospitals, Corea Hospital, Bolivia-Holandes, Los Andes and Senkata (Bolivia-Japones). However, conditions at Senkata Hospital have deteriorated to the point that it is unable to maintain its functions as a secondary hospital. A tertiary hospital should be able to provide all fields of treatment with specialization in certain areas, but there is no tertiary hospital in El Alto as of 2014.

El Alto city can be divided into five medical networks (Figure 5): Bolivia-Holandes, Los Andes, Corea, Senkata (Bolivia-Japones) and Lotes y Servicios, among which the first four networks have secondary medical facilities that are explained above, while secondary medical facilities do not exist in the Lotes y Servicios network. The network in which Corea Hospital belongs is Corea network (Red Corea), following the hospital's name. There are 16 primary health centres in Corea network, four of which are equipped for delivery. However, as most patients do not trust the health centres, many patients go directly to a secondary hospital for delivery.

Each of the five networks does not necessarily treat just the patients from its region. Before the extension of Corea Hospital in 2009, while Bolivia-Holandes and Los Andes networks were able to treat its residents in secondary medical facilities, other networks were not able to provide sufficient medical and health-care services since they did not have secondary medical facilities or their facilities had deteriorated. For these reasons there were many cases of pregnant women that instead of going to the health facilities in their region went to Bolivia-Holandes or Los Andes hospitals to have delivery. Before the hospital had been extended, most expectant mothers residing in Corea network region had to go to other network facilities such as Bolivia-Holandes or Los Andes, or to the few health centres within the network that had delivery facilities. However, since the completion of the extension project, the number of deliveries at Corea Hospital has been increasing.

While specific health-care service networks are designated, residents within networks

Figure 5. Sub-networks in El Alto health-care network

Source: SEDES(<http://www.sedeslapaz.gob.bo/>)

do not necessarily go restrictively to their own regional medical facilities only; instead, patients exhibit very active mobility between various network facilities within El Alto city. This means that El Alto city actually functions as a single large network of medical service facilities, and it seemed most appropriate for it to be considered as such when conducting our analysis, as was also the case for Callao Province in Peru. In the network of El Alto city, there are five sub-networks: Boliviano-Holandes, Corea, Senkata, Los Andes, and Lotes and Servicios. Corea Hospital is a secondary hospital that serves as a central hospital in Corea network, which is one of the five health-care sub-networks in El Alto city. In reality, Corea Hospital is one of the main three hospitals in this region, together with Boliviano-Holandes and Los Andes (Figure 5).

2) Evaluation of the effects of constructing a Hospital in a health-care network

This study analysed the KOICA project, which expanded the capacity of Corea Hospital for maternal and child health care service. The purpose of the project was to increase the deliveries at facilities and to reduce maternal and infant mortality rates. Corea Hospital has a capacity of 95 beds and serves 250,000 of 870,000 residents as a secondary medical facility. The construction of the hospital extension was completed in 2010, and the number of treatments increased by around 20% from 2010 to 2013. Meanwhile, the number of deliveries

Table 4. Numbers of treatments and deliveries at Corea Hospital

year	2009	2010	2011	2012	2013
Number of treatments	-	58,217	62,976	60,365	70,659
Number of deliveries	2,831	3,660	3,652	3,697	3,973

Source: Corea Hospital in El Alto city

Table 5. Population and child deliveries in the network of El Alto city network

	Year	Sub-network					El Alto
		Boliviano-Holandes	Corea	Senkata	Los Andes	Lotes y Servicio	
Population	2008	220,594	245,070		266,025	165,083	896,772
	2009	167,295	261,020	79,986	256,870	163,681	928,852
	2010	172,938	274,779	84,547	259,407	169,095	960,765
	2011	174,050	278,572	90,058	260,607	171,468	974,754
	2012	176,548	282,568	91,351	264,347	173,928	988,742
	2013	176,548	282,568	91,351	264,347	173,928	988,742
Expected number of deliveries	2008	6,305	7,004		7,604	4,719	25,632
	2009	4,720	7,364	2,257	7,247	4,618	26,206
	2010	4,818	7,656	2,356	7,228	4,711	26,769
	2011	4,849	7,761	2,509	7,261	4,777	27,158
	2012	4,919	7,873	2,545	7,365	4,846	27,548
	2013	4,919	7,873	2,545	7,365	4,846	27,548
Number of facility deliveries	2008	4,523	4,218		4,082	508	13,331
	2009	4,379	4,700	261	4,324	571	14,235
	2010	3,719	5,320	420	4,583	560	14,602
	2011	4,162	5,255	422	4,896	563	15,298
	2012	3,696	5,219	520	5,046	522	15,003
	2013	4,149	5,405	661	4,873	600	15,688
Facility delivery rate ^a	2008	71.7%	60.2%		53.7%	10.8%	52.0%
	2009	92.8%	63.8%	11.6%	59.7%	12.4%	54.3%
	2010	77.2%	69.5%	17.8%	63.4%	11.9%	54.5%
	2011	85.8%	67.7%	16.8%	67.4%	11.8%	56.3%
	2012	75.1%	66.3%	20.4%	68.5%	10.8%	54.5%
	2013	84.3%	68.7%	26.0%	66.2%	12.4%	56.9%

Source: SEDES(<http://www.sedeslapaz.gob.bo/>)Note: ^a The facility delivery rate is the rate of each network's expected number of deliveries relative to the number of actual facility deliveries.

increased by around 40% between 2009 and 2013, from 2,831 to 3,973 cases (Table 4). These numbers may be taken as to suggest that the rate of facility-based deliveries had increased markedly. However, this would be a misjudgement based on the wrong assumption that

health-care services are provided by a single provider. Considering that health-care services are provided by the entire network, not just Corea Hospital but also El Alto health-care service network should be analysed in order to accurately assess the impact of the project.

When analysing the impact of Corea Hospital extension project, it is difficult to specifically discern and analyse how the project ultimately influenced overall treatments and deliveries within its own network. This is primarily because Corea Hospital functions as one part of the entire interconnected health-care service network of El Alto city. To understand the extent to which the increase in the number of deliveries at Corea Hospital influenced the rate of facility-based deliveries in the overall region, it is necessary to analyse the entire El Alto health-care service network system. Table 5 presents data on El Alto city's population per network and number of deliveries before and after the project.

When looking at the entire El Alto network data, the number of facility-based deliveries was 14,235 in 2009 and 15,688 in 2013, and the facility-based delivery rate increased from 54.3% in 2009 to 56.9% in 2013 (Table 5). This reveals that neither the number of facility-based deliveries nor the facility-based delivery rate increased markedly. A closer inspection of the change in the number of deliveries for each network reveals that patients moved from one network to another, which resulted in the difference between the expected number of deliveries and the actual number of facility-based deliveries. The Senkata network was separated from the Boliviano-Holandes network in 2009, and this resulted in an apparent movement of 200 deliveries from Boliviano-Holandes network to Senkata network (Table 5). However, this was just a matter of registration, not of a physical movement. Actually, most of the patients in this region continued to go to Bolivia-Holandes Hospital since the infrastructure at a Bolivia-Japones Hospital at Senkata network was outdated. The extension of the service centre at Corea Hospital in 2010 resulted in Corea network attracting facility-based deliveries from the nearby networks; the facility-based deliveries of nearby networks

Table 6. Numbers of deliveries and stillbirths at three main hospitals in El Alto

		Boliviano-Holandes	Corea	Los Andes	Total
Number of deliveries	2008	3,135	2,528	3,298	8,961
	2009	3,195	2,831	3,448	9,474
	2010	2,881	3,660	3,444	9,985
	2011	3,290	3,652	3,593	10,535
	2012	2,954	3,697	3,717	10,368
	2013	3,525	3,973	3,445	10,943
Number of stillbirths	2008	133	60	77	270
	2009	91	63	70	224
	2010	72	87	75	234
	2011	79	78	71	228
	2012	62	71	77	210
	2013	72	84	132	288

Source: SEDES(<http://www.sedeslapaz.gob.bo/>)

Table 7. Proportion of deliveries at secondary hospitals

	Number of facility deliveries	Deliveries at secondary hospitals	Proportion of deliveries at secondary hospitals
2008	13,331	8,961	67.2%
2009	14,235	9,474	66.6%
2010	14,602	9,985	68.4%
2011	15,298	10,535	68.9%
2012	15,003	10,368	69.1%
2013	15,688	10,943	69.8%

Source: SEDES(<http://www.sedeslapaz.gob.bo/>)

mentioned here are those of secondary medical facilities, such as Bolivia-Holandes Hospital, and primary health centres. In other words, women who used to deliver their babies in a health centre now go to Corea Hospital where the equipment and service are of higher quality. This is confirmed in Table 6, which lists the number of deliveries at each hospital.

There were no significant changes in the number of deliveries at Los Andes Hospital. It is possible to suggest that the increase in deliveries at Corea Hospital after its establishment in 2010 was because it attracted pregnant women who would have gone to Bolivia-Holandes Hospital; however, it appears that the number of deliveries changed among the three hospitals. After extending the centre in Corea Hospital, the increase in deliveries seems to be due to the movement of expectant mothers from nearby primary health centres within the network of Corea Hospital. As indicated in Table 7, the rate of deliveries at secondary medical facilities increased. The reduction of deliveries at primary medical facilities indicates that their role in the health care system has decreased, which actually weakens the health-care system.

This project resulted in a significant increase in the number of deliveries within Corea Hospital. However, the number of facility-based deliveries did not increase across the entire health-care service network, and there were no changes in the maternal and child mortality rates, either. The establishment of a new facility has merely led to a movement of patients along different facilities, with no significant increase in the number of total facility-based deliveries of population. Without an overall increase in the number of facility-based deliveries, the increase in the deliveries at secondary hospitals will only act to weaken the position of primary medical facilities and thereby the overall medical system. Moreover, even if expectant mothers tend to prefer secondary hospital for delivery, Atun et al (2015) show that there is no difference in the delivery service between primary and secondary medical facilities.

The increase in the proportion of deliveries at secondary hospitals is contrary to the direction of government policy. The rate of facility-based deliveries in Bolivia is considerably lower than in other Latin American countries, and the government is attempting to increase this rate at a reasonable cost (Lavandenz et al. 2001). The best way to do this is inducing normal deliveries to primary medical facilities, and leading secondary hospitals to take care of caesareans and complicated deliveries.

There is a strong cultural explanation for why the number of facility deliveries has not

increased significantly in Bolivia. In Bolivia, traditional health-care services are officially recognized and the population has a strong faith in traditional practices. It seems that cultural customs lead a large proportion of the population to favour traditional methods of home childbirth over delivery at facilities, especially in rural areas (Rivera et al. 2006; Pooley et al. 2008). Therefore, improving the rate of facility-based deliveries will require complementary programs aimed at transforming the understanding of local residents about deliveries at facilities in addition to the provision of the facilities themselves.

3) Impact

The extension project in 2010 increased the number of treatments by 20% and the number of deliveries by 40%. This was due to patients who had delivered in health centres within the same Corea network or patients who had used hospitals in other networks going to Corea Hospital to utilize its new and innovative infrastructure and equipment. Therefore, it is reasonable to conclude that this project failed to achieve a pure increase in the number of facility-based deliveries, only resulting in a re-distribution of patients across hospitals. The project which originally aimed at increasing the coverage of institutional medical care actually caused a redistribution of patients towards secondary hospitals. This result is consistent with the finding of Pooley et al (2008), that the deliveries in tertiary hospitals increased whereas the proportion of deliveries at facilities did not increase in the rural area.

This project had unexpected outcomes, in that the number of deliveries at primary health centres decreased, which actually distorted and weakened the entire health care system. According to the policy of the Bolivian government, most of the normal deliveries should be assigned to primary health centres, with secondary hospitals only taking delicate and high-risk deliveries such as caesarean deliveries. The decrease in the number of normal deliveries at primary health centres associated with the extension of Corea Hospital exerted an unsuitable effect on the system. Pooley et al (2008) suggested that the government must strengthen the primary health care facilities and lead the secondary hospitals to provide emergency medical services mostly.

The low number of facility-based deliveries is a major problem in Bolivia. The KOICA project was expected to increase the number of facility-based deliveries by extending the infrastructure of Corea Hospital. The present study has shown that this method of increasing facility-based deliveries by only introducing new infrastructure is misconceived, because it ignores how the entire health-care service network operates as a whole. Therefore, other interventions for increasing the facility-based delivery rate need to be considered.

As mentioned above, traditional health-care services are officially recognized as one part of the national health-care system by the Bolivian government. Many people have a strong faith in traditional methods and so avoid delivering child in facilities; these people would not change their minds even when hospital facilities are improved. So, Pooley et al (2008) emphasized the understanding of cultural and gender issues when dealing with deliveries. It is therefore necessary to show them that a facility delivery is much safer than traditional methods. In other words, the provision of medical facilities along with education programs for changing their perceptions is necessary.

4. CONCLUSION

This research shows that when evaluating a Latin American health project, the impact of the project can be exaggerated when only the relevant hospital is analysed, a satisfactory evaluation requires consideration of the entire health-care network. Our evaluations of Bellavista Health Centre in Peru and Corea Hospital in Bolivia revealed that the mother and child health care projects resulted in considerable increases in the number of treatments and deliveries at these hospitals, but these increase merely represented movements of patients among the local hospitals. Therefore, when evaluating the impact of the construction or extension of a medical facility in a health-care network, the outcomes for the relevant hospital, such as number of treatments or child deliveries at that facility, cannot be used to draw accurate conclusions about the impacts. In the case of Peru, the improvement in the quality of medical services in the neighbouring hospitals, reflected in the reduction of waiting time and the increase in treatment time per patient, was the main and important effect of the construction of a new health facility.

In Bolivia, although the extension of Corea Hospital attracted many pregnant women to this hospital, it cannot be considered as a net increase in facility-based deliveries. The consequent decrease in the number of patients in primary health centres was an unexpected outcome of the extension of a secondary hospital. Also, there was no significant increase in facility-based deliveries relative to traditional deliveries within the local health care network. Hence, achieving a higher rate of facility-based deliveries seems to require both extension of the infrastructure and education programs aimed at increasing the trust that people have in medical facilities such as health centres and hospitals relative to traditional medical treatments.

As observed from the cases of Peru and Bolivia, similar interventions have resulted in very different outcomes. In both cases, the number of treatments and deliveries has increased at the facilities where the intervention was carried out. However, from the view point of the local network, the congestion of the neighbouring hospital was reduced and the quality of medical service improved in the case of Peru. In the case of Bolivia, there was a reduction of deliveries in the primary health centres, which was opposite to the policy direction of the government. In any case, this paper suggests that considering the effect on the local health network is extreme important when designing health projects.

Article Received: 18-09-2020 Revised: 11-12-2020 Accepted: 17-10-2020

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